3745-1-40 <u>Methodologies for development of aquatic life criteria for the Ohio river drainage basin</u>.

This rule applies to water bodies located in the Ohio river drainage basin.  All pollutants or combinations of pollutants, for which aquatic life criteria have not been adopted in rule 3745-1-07 or 3745-1-34 of the Administrative Code, shall not exceed the water quality criteria derived using the procedures contained in this rule.

(A)  Acute aquatic criterion (AAC).  This criterion applies outside the mixing zone to all aquatic life habitat use designations.  This criterion shall be calculated by one of the following two methods and shall be expressed as the quantity of chemical per liter of water (e.g., mg/l or ug/l).  Paragraphs (A)(1) to (A)(3) of this rule shall be used when acute toxicity data are available for species in at least six families.  Paragraph (A)(4) of this rule shall be used when there are not enough toxicity data to use the procedures in paragraphs (A)(1) to (A)(3) of this rule but there are at least one $EC_{50}$ value for a species in the family Daphnidae and one $LC_{50}$ value for either fathead minnow, bluegill or rainbow trout.

   (1)  The procedures in paragraphs (A)(1) to (A)(3) of this rule shall be used to calculate the AAC when $LC_{50}$ or $EC_{50}$ data for at least one species of freshwater animal in at least the six different families identified in paragraphs (A)(1)(a) to (A)(1)(f) of this rule are included.  Resident species data are preferred for the data base.  However, if such data are not available, data for nonresident species may be used.  These nonresident species shall serve as representatives of resident species for which data are unavailable:

      (a)  The family Salmonidae (salmon and trout) or, for warmwater habitats, a sensitive warmwater fish species;

      (b)  The family Cyprinidae (minnows) or Centrarchidae (sunfishes);

      (c)  A third family in the class Osteichthyes (bony fishes) not already represented;

      (d)  The family Daphnidae (water fleas);

      (e)  A benthic macroinvertebrate;

      (f)  A third invertebrate family not already

represented in paragraph (A)(1)(d) or (A)(1)(e) of this rule.

(2) When data are not available to show that acute toxicity to two or more species is similarly related to a water quality characteristic (e.g., hardness, pH or temperature), the AAC shall be calculated using the procedures in paragraphs (A)(2)(a) to (A)(2)(h) of this rule.

   (a) For each species for which at least one acute value is available, the species mean acute value (SMAV) shall be calculated as the geometric mean of the results of all flow-through tests in which the concentrations of test material were measured. For a species for which no such result is available, the SMAV shall be calculated as the geometric mean of all available acute values, i.e., results of flow-through tests in which the concentrations were not measured and results of static and renewal tests based on initial concentrations of test material.

   (b) For each genus for which one or more SMAVs are available, the genus mean acute value (GMAV) shall be calculated as the geometric mean of the SMAVs available for the genus.

   (c) The GMAVs shall be ordered from high to low.

   (d) Ranks (R) shall be assigned to the GMAVs from "one" for the lowest to "N" for the highest.  If two or more GMAVs are identical, successive ranks shall be arbitrarily assigned.

   (e) The cumulative probability, P, shall be calculated for each GMAV as R/(N + 1).

   (f) The (T) GMAVs (T = three for N = six or seven; T = four for N = eight or greater) are selected which have cumulative probabilities closest to 0.05.  If there are less than fifty-nine GMAVs, these will always be the three (for N = six or seven) or four (for N = eight or greater) lowest GMAVs.

   (g) Using the selected Ps and the natural logarithm (ln) of the selected GMAVs, the final acute value (FAV) and the AAC are calculated as:

$$S^2 = \frac{\sum((\ln GMAV)^2) - \frac{(\sum(\ln GMAV))^2}{T}}{\sum(P) - \frac{(\sum(\sqrt{P}))^2}{T}}$$

$$L = \frac{\sum(\ln GMAV) - S(\sum(\sqrt{P}))}{T}$$

$$A = S(\sqrt{0.05}) + L$$

$$FAV = e^A$$

$$AAC = FAV/2.$$

(h) If, for a commercially, recreationally or ecologically important species, the geometric mean of the acute values from flow-through tests in which the concentrations of test material were measured is lower than the calculated FAV, then that geometric mean shall be used as the FAV instead of the calculated FAV.

(3) When enough data are available to show that acute toxicity to two or more species is similarly related to a water quality characteristic (e.g., hardness, pH or temperature), the AAC shall be calculated using the procedures in paragraphs (A)(3)(a) to (A)(3)(k) of this rule.

(a) For each species for which comparable acute toxicity values are available at two or more different values of the water quality characteristic, a least squares regression of the acute toxicity values on the corresponding values of the water quality characteristic shall be performed to obtain the slope. Because the best documented relationship is that between hardness and acute toxicity of metals and a log-log relationship fits these data, geometric means and natural logarithms of both toxicity and water quality shall be used in the rest of this method. For relationships based on other water quality characteristics, such as pH or temperature, no transformation or a different transformation might

fit the data better, and appropriate changes shall
be made as necessary throughout this method.

(b) Each acute slope shall be evaluated as to whether
or not it is meaningful, taking into account the
range and number of the tested values of the water
quality characteristic and the degree of agreement
within and between species.  If meaningful slopes
are not available for at least one fish and one
invertebrate, or if the available slopes are too
dissimilar, or if too few data are available to
adequately define the relationship between acute
toxicity and the water quality characteristic, the
AAC shall be calculated using the procedures in
paragraph (A)(2) of this rule.

(c) Individually, for each species, the geometric mean
of the available acute values shall be calculated
and then each of the acute values for a species
shall be divided by the mean for the species.
This normalizes the acute values so that the
geometric mean of the normalized values for each
species individually and for any combination of
species is 1.0.

(d) The values of the water quality characteristic
shall be similarly normalized for each species
individually.

(e) All the normalized data shall be treated as if
they were for the same species and a least squares
regression of all the normalized acute values on
the corresponding normalized values of the water
quality characteristic is performed to obtain the
pooled acute slope, V.

(f) For each species the geometric mean, W, of the
acute toxicity values and the geometric mean, X,
of the values of the water quality characteristic
shall be calculated.  (These were calculated in
paragraphs (A)(3)(c) and (A)(3)(d) of this rule.)

(g) For each species the natural logarithm (ln), V, of
the species mean acute value (SMAV) at a selected
value, Z, of the water quality characteristic
shall be calculated using the equation:

$Y = \ln W - v(\ln X - \ln Z)$.

(h) For each species the SMAV at Z shall be calculated using the equation:

$$SMAV = e^Y.$$

(i) The AAC shall be obtained by using the procedures described in paragraphs (A)(2)(b) to (A)(2)(h) of this rule.

(j) The acute aquatic intercept (AAI) shall be calculated using the equation:

$$AAI = e^{[\ln AAC - V(\ln Z)]}.$$

(k) The AAC equation shall be written as:

$$AAC = e^{[V \ln(\text{water quality characteristic}) + \ln AAI]}.$$

(4) If the required data to derive the AAC in paragraphs (A)(1) to (A)(3) of this rule are not present in the acute toxicity data base and at least one $LC_{50}$ or $EC_{50}$ value is available for a species in the family Daphnidae and either fathead minnow, bluegill or rainbow trout, a FAV shall be calculated by dividing the lowest SMAV among the daphnid species, fathead minnow, bluegill and rainbow trout by five if rainbow trout are represented or ten if rainbow trout are not represented. The AAC equals the FAV divided by two. If appropriate, the AAC shall be made a function of a water quality characteristic in a manner similar to that described in paragraph (A)(3) of this rule.

(B) Chronic aquatic criterion (CAC). This criterion applies outside the mixing zone to all aquatic life habitat use designations except the limited resource water use designation. This criterion shall be calculated by one of the following two methods and shall be expressed as the quantity of chemical per liter of water (e.g., mg/l or ug/l). Paragraph (B)(1) of this rule shall be used when chronic toxicity data are available for species in at least six families as specified in paragraph (A)(1) of this rule. Paragraph (B)(2) of this rule shall be used when there are not enough toxicity data to use the method in paragraph (B)(1) of this rule.

(1) The CAC shall be derived in the same manner as the FAV in paragraphs (A)(1) to (A)(3) of this rule by substituting CAC for FAV, chronic for acute, MATC

(maximum acceptable toxicant concentration) for $LC_{50}$ or $EC_{50}$, SMCV (species mean chronic value) for SMAV, and GMCV (genus mean chronic value) for GMAV.

(2)    If chronic data for a chemical are not available for at least six freshwater species meeting the requirements in paragraph (A)(1) of this rule, the CAC shall be calculated by dividing the FAV by an acute-chronic ratio (or geometric mean if more than one is available) for at least one North American freshwater species.  If no acute-chronic ratio is available, the CAC shall be calculated by dividing the FAV by forty-five.  If, for a commercially, recreationally or ecologically important species, the geometric mean of the chronic values is lower than the calculated CAC, then that geometric mean shall be used as the CAC instead of the calculated CAC.

(C) Application of criteria and values.

(1)    The FAV shall be applied as a maximum concentration inside the mixing zone.

(2)    The AAC shall be applied as a maximum concentration outside the mixing zone.

(3)    The CAC shall be applied as a thirty-day average concentration outside the mixing zone.